Converges by direct comparison

16. $$\sum_{n=1}^{\infty} \frac{5n^3-3n}{\cancel{n^2(n+2)(n^2+5)}} < \sum_{n=1}^{\infty} \frac{5n^3}{n^5} = \sum_{n=1}^{\infty} \frac{5}{n^2}$$

$n^5+2n^4+5n^3+10n^2$

$(n+2)(n^2+5)$

$n^3+2n^2+5n+10$

p-series
$p=2$
converges

or limit comparison

$$\lim_{n\to\infty} \frac{5n^3-3n}{n^5+\ldots} \cdot \frac{n^5}{5n^3} = 1$$

says: both series behave same

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17. $$\sum_{n=1}^{\infty} \frac{3^{n-1}+1}{3^n}$$

diverges by $n^{th}$ term test

$$\sum_{n=1}^{\infty} \frac{3^{n-1}}{3^n} + \frac{1}{3^n}$$

$$\sum_{n=1}^{\infty} \frac{1}{3} + \frac{1}{3^n} \to \frac{1}{3}$$

$n^{th}$ term test

$$\lim_{n\to\infty} \frac{1}{3}+\frac{1}{3^n} = \frac{1}{3}$$

not 0

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9.5 Absolute vs Conditional Convergence
intervals of convergence

absolute convergence - $\sum |a_n|$ converges
or ~~and~~ then $\sum a_n$ converges

conditional convergence - $\sum |a_n|$ diverges
or but $\sum a_n$ converges

neither: both diverge

has some neg terms
use AST

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does $\sum_{n=1}^{\infty} (-1)^{n+1} \frac{1}{n}$ converge absolutely, conditionally or neither.

seq: $1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \dots$

start with abs. $\sum_{n=1}^{\infty} \left| (-1)^{n+1} \frac{1}{n} \right| = \sum_{n=1}^{\infty} \frac{1}{n} = 1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} \dots$

series = sum of all terms

p-series $p=1$, harmonic } diverges

without abs

$$\sum_{n=1}^{\infty} (-1)^{n+1} \frac{1}{n} = 1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \frac{1}{5} \dots$$

converges by AST:

1. signs alternate ✓
2. |terms| get smaller ✓
3. $a_n \to 0$ ✓

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what does $1-\frac{1}{2}+\frac{1}{3}-\frac{1}{4}+\frac{1}{5}\cdots$ converge to?

$$\ln(1+x) = x-\frac{x^2}{2}+\frac{x^3}{3}-\frac{x^4}{4}+\frac{x^5}{5}\cdots(-1)^{n+1}\frac{x^n}{n}$$

let $x=1$

$$\ln 2 = 1-\frac{1}{2}+\frac{1}{3}-\frac{1}{4}+\frac{1}{5}\cdots$$

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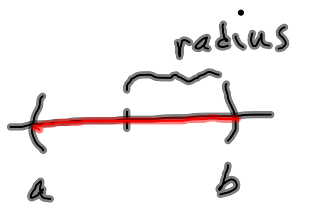
Intervals of convergence - values of $x$ for which the series converges




1. do the interior (ratio test)

2. then do endpoints

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Ex 6 a $\sum_{n=1}^{\infty} (-1)^{n+1} \frac{x^{2n}}{2n}$ find the interval of convergence

ioc

1. ratio test

$$\lim_{n\to\infty} \left| \frac{x^{\cancel{2(n+1)}}}{2(n+1)} \cdot \frac{2n}{\cancel{x^{2n}}} \right| = \lim_{n\to\infty} \left| x^2 \cdot \frac{2n}{2n+2} \right|$$

$\frac{2n}{2n+2} \to 1$

$$\frac{x^{2n+2}}{x^{2n}} = x^2$$

$$= x^2 < 1$$

$$\boxed{-1 \leq x \leq 1}$$

2. endpts $x = 1$ plug in $\sum_{n=1}^{\infty} (-1)^{n+1} \frac{1^{2n}}{2n} = \frac{1}{2} - \frac{1}{4} + \frac{1}{6} \dots$

converges by AST

$x = -1$ $\sum_{n=1}^{\infty} (-1)^{n+1} \frac{(-1)^{2n}}{2n} = \frac{1}{2} - \frac{1}{4} + \frac{1}{6} \dots$

converges by AST

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